Heath[redacted]

VOLTAGE REFERENCE SOURCE

EUW-16A

(Zener Stabilized)

Model EUW-16A

SERVICE INFORMATION

The following Heath Company services are available if you need them: Replacement Parts, Technical Consultation, and Factory Service. Address all correspondence to:

HEATH COMPANY
Benton Harbor, Michigan 49023

For prompt service, use a separate letter for each department you write to.

REPLACEMENT PARTS

If a replacement part is needed, please include the following information in your letter:

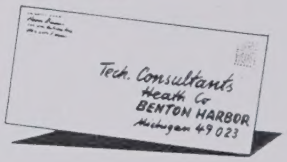
1. Part number and description.
2. Model Number and Series Number of the equipment.

If your equipment is in the Warranty period, add:

3. Date of purchase.
4. Nature of defect.

Heath Company will fill your order promptly. Please DO NOT RETURN PARTS unless they are requested. Parts that are damaged through carelessness or misuse by the customer will not be replaced without cost.

TECHNICAL CONSULTATION



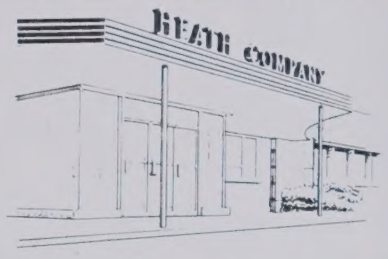
You can write to our Technical Consultants for help with any Heath equipment, or for answers to any questions about the use of this equipment.

The completeness and accuracy of the advice mailed back to you depends entirely on the information in your letter. Be sure to include:

1. The Model Number and Series Number of the equipment (on blue identification label).
2. Date of purchase.
3. An exact description of the difficulty. Include switch positions, connections to other units, operating procedures, voltage reading, and any other information you think might be helpful.
4. List everything you have done in attempting to correct the difficulty.

FACTORY REPAIR SERVICE

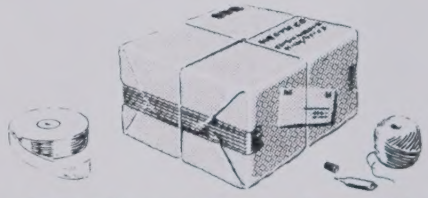
You can return your equipment to the Heath Company Service Department to have it repaired for a minimum service fee. (Equipment that has been modified will not be accepted for repair.) Refer to Shipping Instructions for details on how to package and ship the equipment.



To be eligible for replacement parts under the terms of the Warranty, equipment returned for Factory Repair Service must be accompanied by the invoice or the sales slip, or a copy of either. (If you send the original invoice or sales slip, it will be returned to you.)

SHIPPING INSTRUCTIONS

Check the equipment to see that all parts and screws are in place. Then, wrap the equipment in heavy paper. Place the equipment in a strong carton, and put at least three inches of resilient packing material (shredded paper, excelsior, etc.) on all sides, between the equipment and the carton.



Seal the carton with gummed paper tape and tie it with a strong cord. Ship it by prepaid Express or insured Parcel Post to:

HEATH COMPANY
Benton Harbor, Michigan 49023

Attach a letter containing the following information, to the outside of the carton:

1. Your name and return address.
2. Date of purchase.
3. A brief description of the difficulty.
4. Your authorization to ship the repaired unit back to you C.O.D. for the service and shipping charges, plus the cost of parts not covered by the Warranty.

OPERATION OF THE HEATH VOLTAGE REFERENCE SOURCE

(Zener Stabilized)

MODEL EUW-16A

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HEATH COMPANY
BENTON HARBOR, MICHIGAN

595-755

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SPECIFICATIONS

Output Voltage	0-100 volts DC, Zener stabilized.
Maximum Load (minimum load resistance)	150 KΩ on all ranges to keep the unit within specified accuracy.
Resolution	.1 mv on X1 range. 1 mv on X10 range. 10 mv on X100 range. 100 mv on X1000 range.
Accuracy	±1% for Coarse Voltage settings and ±2% for Fine Voltage settings.
Readout	Directly on three dials: Coarse Voltage, Fine Voltage, Range.
Controls -	
Coarse Voltage	0-90 mv, in 10 mv steps (plus a -5 position).
Fine Voltage	0-10 mv, continuous.
Range	X1, X10, X100, X1000.
Output Selector	Four positions: AC Off, Signal, STD Voltages, Sum-Difference.
Polarity Switch	Normal (Sum) position, or Reverse (Difference) position.
Pushbutton Zero	Shorts Output terminals together.
Power Required	25 watts, 117 V AC, 50/60 cps.
Fuses	Line: 1/2 ampere slow-blow. Output: 1/32 ampere.
Dimensions	5-3/4" high x 8-1/4" wide x 8" deep.
Net Weight	4-1/2 lbs.
Shipping Weight	5 lbs.

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

INTRODUCTION

The Voltage Reference Source can be used for many different applications in experimental and development work. The Output switch selects the mode of operation, allowing the unit to be operated as a standard voltage source or for sum and difference voltage comparisons. The Signal position allows an input signal to be connected directly to the Output terminals.

In standard voltage (Std Volt) applications an accurate DC voltage, which can be varied from 100 volts to a few tenths of a millivolt, is available at the Output terminals. The amount of voltage at the terminals can be accurately read directly from the Coarse, Fine, and Range dials on the front panel. The polarity of this standard voltage may be reversed by the Polarity switch. Note that this unit is a voltage source, it should not be used as a power supply.

In Sum-Difference applications, the sum of or difference between the input signal voltage and the standard voltage is present at the Output terminals. Slide-wire potentiometer operation is simulated in the Difference position. The DC voltage being checked is connected to the Signal terminals and a null meter is connected to the Output terminals. When the null meter indicates zero, the two voltages are equal, and the unknown DC voltage can be read directly from the Coarse, Fine and Range dials on the front panel. This is an extremely accurate method of measuring voltage; changes in voltage due to loading are eliminated since no current is drawn from either voltage supply.

In the Signal position of the Output switch, the input signal is connected directly to the Output terminals. This allows the signal and the standard voltage to be connected to the Output terminals alternately by merely switching the Output switch.

Other operating conveniences in this unit include the pushbutton Zero switch and the -5 position of the Coarse voltage switch. The Zero switch shorts the Output terminals together, giving a handy zero reference voltage to the meter, oscilloscope, or other instrument connected to these terminals.

The minus (-5) position of the Coarse voltage switch provides a continuously variable minus (-) to plus (+) standard voltage at the Output terminals. This variable voltage will be in one of the following ranges, depending on the Range switch setting: -5 to +5 mv, -50 to +50 mv, -0.5 to +0.5 volt, or -5 to +5 volts.

This instrument is one of the units included in the Malmstadt-Enke EU-100A Instrumentation Laboratory. It is available as an individual unit, or it can be purchased at a special group price when included with the total EU-100A System. The units of the complete EU-100A Laboratory Station are useful not only in learning electronic concepts, but also in research and development, and control instrumentation.

OPERATION

STANDARD REFERENCE VOLTAGE OPERATION

Refer to Figure 1.

Turn the OUTPUT switch to the STD VOLT position.

Turn the RANGE switch so the unit gives a standard OUTPUT voltage on one of the following four voltage ranges:

X1 range = 0-100 mv
X10 range = 0-1000 mv (0-1V)
X100 range = 0-10 volts
X1000 range = 0-100 volts

The COARSE switch and FINE control are then adjusted as follows for the desired OUTPUT voltage: The sum of the readings set on the COARSE control and on the 0 to 10 scale of the FINE control will be added together. This sum is then multiplied by the reading of the RANGE switch to give the amount of voltage at the OUTPUT terminals. The -5 range of the COARSE control and the -5, 0, +5 range of the FINE control will be explained separately.

Control Setting Examples:

COARSE	FINE	RANGE	
70	+ 3	X1	= 73 mv.
40	+ 5	X10	= 450 mv or .45 volt.
20	+ 5	X100	= 2500 mv or 2.5 volts.
30	+ 9	X1000	= 39,000 mv or 39 volts.

After the unit is set to give the correct OUTPUT voltage, connect the meter, or other device to which the voltage is to be supplied, to the OUTPUT terminals. NOTE: Do not use this unit as a power supply, it has been designed to be used as an accurate voltage source, not to supply current.

When the POLARITY switch is in the NORMAL position, the output voltage will have the polarity that is marked at the OUTPUT terminals. In the REVERSE position, the polarity of this voltage will be reversed from the way it is marked at the terminals.

NOTE: If in some applications a 60 cps component is noticed in the output of the Voltage Reference Source, it can generally be eliminated by reversing the ACline cord plug.

The ZERO button is used to disconnect the standard voltage from the positive (+) output terminal. The positive (+) and negative (-) terminals are then shorted together, giving a zero reference voltage at the OUTPUT.

The -5 range of the COARSE control is only used with the -5, 0, +5 range of the FINE control. When these ranges are used, the following range of voltage values becomes available at the OUTPUT terminals, depending on the RANGE switch setting.

RANGE SWITCH	OUTPUT VOLTAGE
X1	-5 mv to +5 mv
X10	-50 mv to +50 mv
X100	-500 mv to +500 mv
X1000	-5 volts to +5 volts

SUM-DIFFERENCE OPERATION

When the OUTPUT switch is turned to the SUM-DIFF position, a comparison can be made between an external voltage connected to the SIGNAL terminals, and the standard voltage of the Voltage Reference Source. The setting of the POLARITY switch determines whether it is the sum of the two voltages, or the difference between them that appears at the OUTPUT terminals.

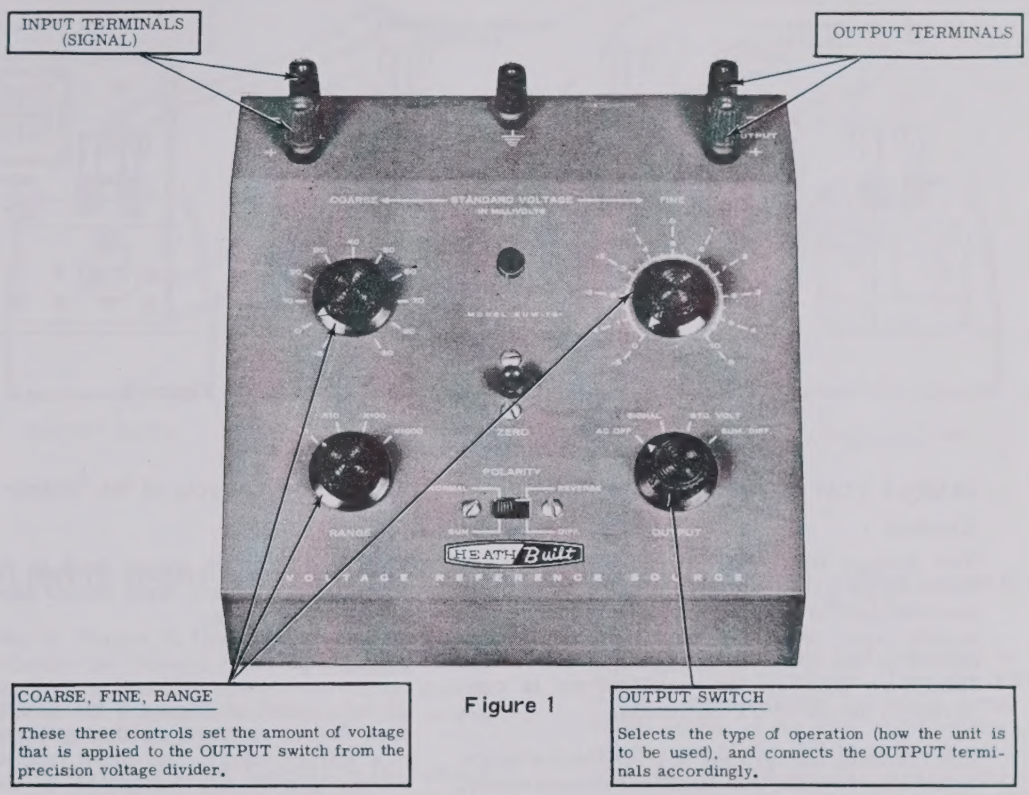

INPUT TERMINALS (SIGNAL)
OUTPUT TERMINALS
COARSE, FINE, RANGE
These three controls set the amount of voltage that is applied to the OUTPUT switch from the precision voltage divider.
OUTPUT SWITCH
Selects the type of operation (how the unit is to be used), and connects the OUTPUT terminals accordingly.

Figure 1

The following method should be used to determine the accurate value of an unknown (or questionable) voltage. This is the same method that is used to determine unknown voltages with slide-wire potentiometer.

1. Place the OUTPUT switch in the SUM-DIFF position.

2. Connect the unknown voltage to the SIGNAL terminals, with the polarity as marked at the terminals.

3. Connect a null meter to the OUTPUT terminals. Place the POLARITY switch in the DIFF position.

4. Adjust the RANGE, COARSE, and FINE controls to obtain a zero voltage indication on the NULL meter. When this point is found, the exact value of the unknown voltage is indicated by these three controls.

In the SIGNAL position of the OUTPUT switch, the SIGNAL terminals are connected directly to the OUTPUT terminals. This allows the input signal and the standard voltage to be connected to the OUTPUT terminals alternately by merely switching the OUTPUT switch between the SIGNAL and STD VOLT positions.

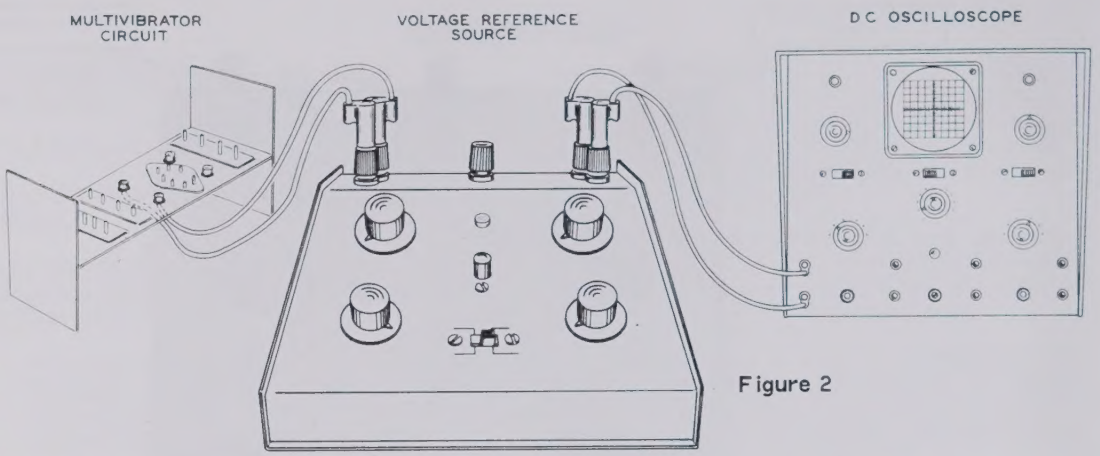


Figure 2

SAMPLE TEST SETUPS

Example 1

The Voltage Reference Source is used to determine the amplitude of a square wave on an oscilloscope in Figure 2. In this Figure, the square wave from the multivibrator is connected to the SIGNAL terminals of the Voltage Reference Source. The oscilloscope is connected to the OUTPUT terminals.

The following paragraphs describe each step you would take to make this amplitude measurement. So the steps will be easier to follow, they are written as if you were actually performing the tests.

Turn the OUTPUT switch of the Voltage Reference Source to the SIGNAL position. Align the top and the bottom of the square wave to some easy-to-find reference points on the oscilloscope screen.

Place the OUTPUT switch of the Reference Source in the STD VOLT position, a straight line should now appear on the oscilloscope. Push the ZERO switch and move this line to the same position as that of the bottom of the square wave.

Release the ZERO button and adjust the COARSE, FINE, and RANGE switches until the line moves to the same position as the top of the square wave. The height of the square wave is now shown by the readings of the COARSE, FINE, and RANGE controls of the Voltage Reference Source.

Turn the OUTPUT switch back to the SIGNAL position, the square wave should appear on the oscilloscope again.

Example 2

In the circuit of Figure 3 the Voltage Reference Source is being used to calibrate the dial on a voltage supply. The output terminals of the voltage supply are connected to the SIGNAL terminals of the Voltage Reference Source. The OUTPUT terminals of the Voltage Reference Source are connected to a null indicator. A current limiting resistor should be used in series with one lead to protect the null indicator from overloads.

The switch positions of the Voltage Reference Source are as follows: OUTPUT switch = SUM DIFF, POLARITY switch = DIFF, the positions of the other controls will be adjusted as follows.

Turn the pointer on the voltage supply to one of the marks that must be calibrated. Adjust the RANGE, COARSE, and FINE controls of the Voltage Reference Source for a ZERO indication on the NULL indicator. When this point is found the two voltages are equal, and the supply voltage is indicated by the dials of the Voltage Reference Source. This same process is repeated for each point to be calibrated on the dial of the voltage supply.

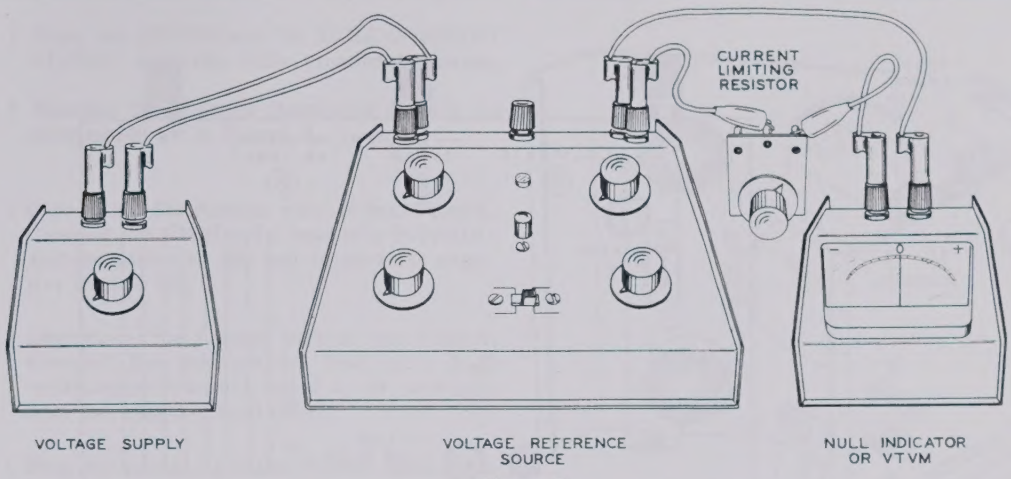


Figure 3

CALIBRATION

CALIBRATE ADJUST-METHOD 1

Refer to Figure 4. Use the following method to calibrate the Voltage Reference Source (VRS). This method balances an accurate voltage source such as a Potentiometer against the output voltage of the VRS.

1. Set the front panel controls to the voltage output of the accurate voltage source (.1, 1, 10, or 100 volts).
2. Connect the accurate voltage source to the SIGNAL terminals of the VRS.
3. Connect a VTVM or null indicator to the VRS OUTPUT terminals. Turn the VTVM to the lowest useable DC range, press the ZERO button of the VRS, and turn the zero adjust knob of the VTVM so that it will indicate zero volts at some arbitrary reference position near mid-scale. Release the ZERO button.

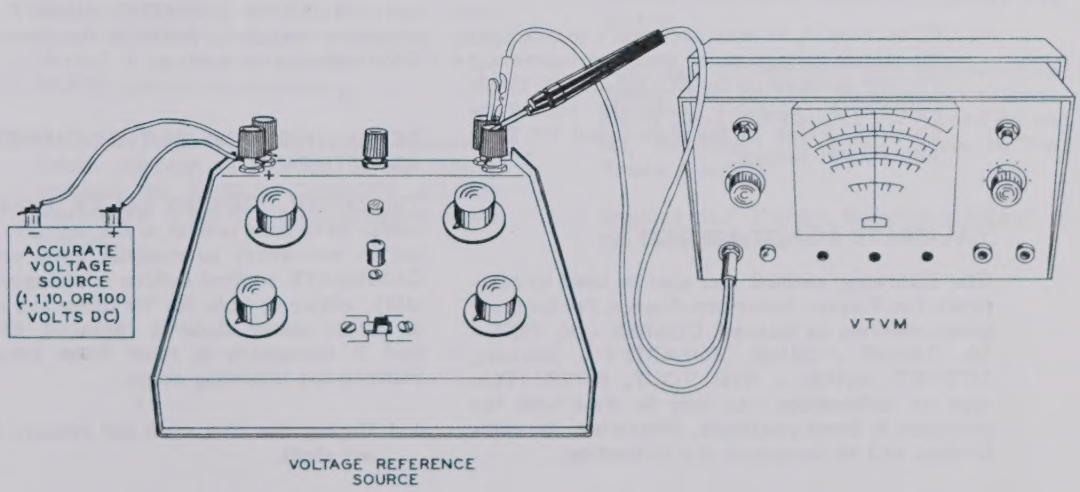


Figure 4

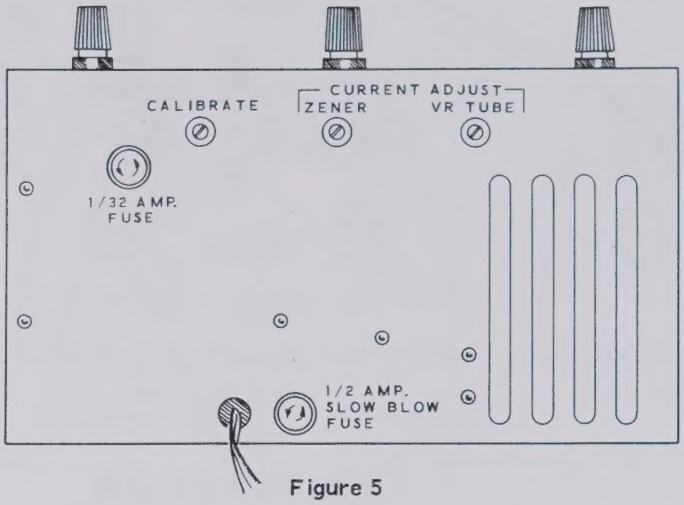


Figure 5

4. Refer to Figure 5 and adjust the CALIBRATE control (at the rear of the Voltage Reference Source), without pressing the ZERO button, to obtain the same zero voltage indication on the VTVM.

5. Press and release the ZERO button several times to make sure the unit is adjusted exactly to zero volts. The calibration is now complete, remove the accurate voltage source and the VTVM leads.

6. If, in step 5, it was necessary to readjust the output voltage more than approximately 1%, the settings of the ZENER and VR TUBE CURRENT ADJUST controls should be checked. Refer to the Zener and VR Tube Adjustment section.

CALIBRATE ADJUST-METHOD 2

The following method can also be used to calibrate the Voltage Reference Source. Set the front panel controls as follows: COARSE - 90, FINE - 10, RANGE - X1000, POLARITY - Normal, OUTPUT switch - STD VOLT. NOTE: This type of calibration can only be done with the switches in these positions, otherwise, the calibration will be incorrect due to loading.

Connect a 1000 Ω/ volt (or greater) precision meter (or other precision voltage measuring device) to the OUTPUT terminals of the Voltage Reference Source.

The CALIBRATE control, which is adjusted with a screwdriver is accessible from the rear of the unit. Adjust the CALIBRATE control so the meter indicates exactly 100 volts. If it was necessary to readjust the output voltage more than approximately 1%, the setting of the ZENER and VR TUBE CURRENT ADJUST controls should be checked. Refer to the Zener and VR Tube Adjustment section.

ZENER DIODE AND VR TUBE CURRENT ADJUSTMENT

The ZENER CURRENT and VR TUBE adjustments have been preset at the factory. It should not be necessary to readjust them unless the CALIBRATE control setting is changed appreciably, either or both the VR tubes are replaced, or if the zener diode is replaced. Should you find it necessary to reset these adjustments, refer to the following steps.

( ) Unplug the line cord and remove the cabinet shell.

( ) Turn the ZENER and VR TUBE CURRENT ADJUST controls fully counterclockwise.

( ) Position the Voltage Reference Source on edge as shown in Figure 6.

( ) Disconnect the jumper wire at Test Point B. Connect the positive (+) lead of a 0-5 milliampere meter to B1, and connect the negative lead to B2.

( ) Disconnect the jumper wire at Test Point A. Connect the positive (+) lead of a 0-20 milliampere current meter to A1, and connect the negative lead to A2.

( ) Plug the line cord of the Voltage Reference Source into a 117 volt AC power source. NOTE: It is important that this adjustment be made at a known or controlled value of 117 volts.

( ) Adjust the ZENER CURRENT ADJUST control until the milliammeter reads between 2.3 and 2.5 milliamperes.

( ) Adjust the VR TUBE CURRENT ADJUST control for a meter reading between 15 and 17 milliamperes.

( ) Before readjusting the Zener current, check the CALIBRATE control setting by using Method 1 or Method 2. Adjust the CALIBRATE control as necessary.

( ) Check to make sure the proper amount of Zener current is flowing. If necessary, readjust the ZENER CURRENT ADJUST control for a 2.3 to 2.5 milliampere meter reading.

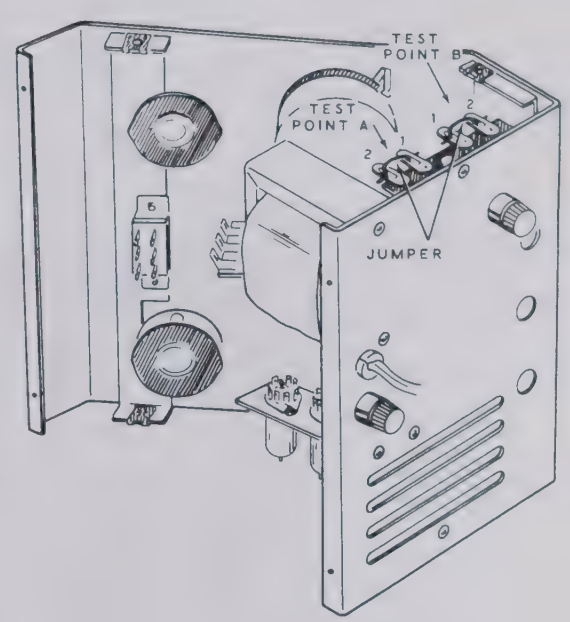
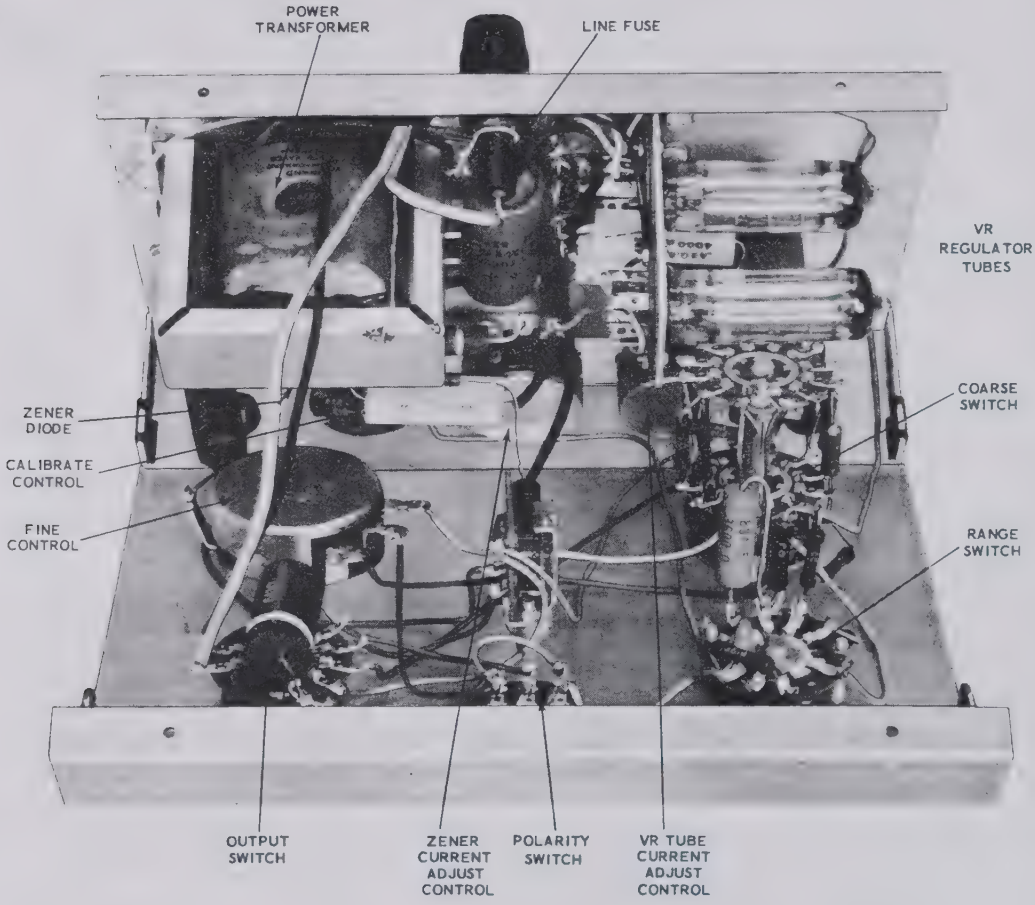


Figure 6

( ) Repeat the previous three steps until the VR tube current is between 15 and 17 milliamperes and the zener current is between 2.3 and 2.5 milliamperes when the Voltage Reference Source is properly calibrated.

( ) Turn the Voltage Reference Source off and unplug the line cord. Remove the milliammeter from between A1 and A2 and B1 and B2. Reconnect the jumper wires to Test Points A and B.

( ) Replace the Voltage Reference Source in the cabinet shell.


POWER TRANSFORMER
LINE FUSE
VR REGULATOR TUBES
COARSE SWITCH
ZENER DIODE
CALIBRATE CONTROL
FINE CONTROL
RANGE SWITCH
OUTPUT SWITCH
ZENER CURRENT ADJUST CONTROL
POLARITY SWITCH
VR TUBE CURRENT ADJUST CONTROL

REPLACEMENT PARTS

This list includes only those parts which may be difficult to obtain locally, if replacement is required.

PART No.	DESCRIPTION
2-167	4 Ω, 1/2 watt precision resistor ±1%
2-168	36.4 Ω, 1/2 watt precision resistor ±1%
2-197	360 Ω, 1/2 watt precision resistor ±1%
2-111	400 Ω, 1/2 watt precision resistor ±1%
2-169	404 Ω, 1/2 watt precision resistor ±1%
3E-9	3000 Ω, 5 watt wire-wound resistor ±5%
3E-22	3600 Ω, 5 watt precision wire-wound resistor ±1%
3G-8	4000 Ω, 7 watt wire-wound resistor ±10%
3G-23	5600 Ω, 7 watt wire-wound resistor ±10%
11-46	800 Ω control, ±1% linearity
11-40	1000 Ω control, screwdriver slot
11-34	10 KΩ control, screwdriver slot

PART No.	DESCRIPTION
23-53	.1 μfd capacitor, 400 V
23-20	1 μfd capacitor, 200 V
25-20	40 μfd electrolytic capacitor, 150 V
25-43	70 μfd electrolytic capacitor, 350 V
54-162	Power transformer
56-29	Zener diode, 110 V, 1 W, 10%
57-27	Silicon diode, 500 PIV
60-2	Slide switch, DPDT
63-391	4-position switch, 2-pole
63-307	4-position switch, 3-pole
63-308	11-position rotary switch
64-19	Pushbutton switch
411-46	OB2 tube
412-13	Neon lamp
421-38	1/32 ampere fuse
462-52	Knob with pointer
462-132	Pushbutton knob

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram while reading this Circuit Description. This Voltage Reference Source consists of three main sections; the regulated power supply, a precision voltage divider network, and the output switching circuits.

REGULATED POWER SUPPLY

The AC line voltage is applied through the ON-OFF switch (on the Output switch) and through a slow-blow fuse to the primary of the power transformer. The voltage from the secondary of the power transformer is rectified by two silicon diodes in a half-wave circuit.

The rectified voltage is applied across a 70 μfd filter capacitor, and through a series resistance to a shunt regulator circuit consisting of two OB2 voltage regulator (VR) tubes. Following this is a second stage of filtering and voltage regulation, consisting of a 40 μfd capacitor and a 110 volt zener diode.

Both the VR tubes and the zener diode are used to maintain a constant output voltage, despite changes in line voltage. An increase in line voltage will tend to increase the voltage across the VR tubes. This voltage can not increase substantially due to the constant voltage characteristics of the VR tubes. The VR tubes will then draw more current, and the voltage drop across the resistance in series with the VR tubes will increase, thus maintaining a substantially constant voltage across the VR tubes.

The zener diode, in conjunction with its series resistance aids the regulation in a similar manner. Slight voltage changes across the VR tubes are further reduced by the zener characteristics. Therefore, any attempt to change the voltage across the zener diode will cause a large change in zener current, a resulting change in the voltage drop across the series resistance, and the output voltage will remain constant.

PRECISION VOLTAGE DIVIDER

The regulated output voltage from the filter circuit is applied through the Calibrate control to the Range switch. The calibrate control is adjusted to obtain an accurate 100 volts between the arms of the Range switch.

The Range switch is constructed in two sections to present a constant load to the power supply. It applies the 100 volts directly across the precision voltage divider of the Coarse switch in the X1000 position. In the other Range positions, the input voltage is divided by 10, 100, or 1000.

The output of the Range switch is coupled directly across the eleven 400 Ω precision resistors of the Coarse switch. Two of these 400 Ω resistors are always shunted by the 800 Ω Fine control, giving a total resistance across this section of 400 Ω; this keeps the total resistance of the divider at 4000 Ω. Thus, if 100 volts is connected across the complete divider, a 10 volt segment is always connected across the Fine voltage control. Which 10 volt segment is selected depends on the setting of the Coarse switch.

For positions 0 through 90 of the Coarse voltage switch, a standard output voltage is taken from between the arm of the Fine voltage control and DC-.

In the -5 position of the Coarse switch, the Fine control is connected across the last two resistors in the divider. In this position the output voltage is referenced to the center of the last two 400 Ω resistors, instead of from DC-. As a result, the voltage from the arm of the Fine control now varies above (+5) and below (-5) the reference. The setting of the Range switch determines whether this -5 and +5 will be in volts or millivolts. A 1/32 ampere fuse is connected in series with the Output terminals to

protect the Fine control and precision resistors from burnout in case an external voltage is accidentally applied to the Output terminals.

OUTPUT SWITCHING CIRCUITS

The output of the precision voltage divider network is coupled through the Polarity switch to the Output switch. The Output switch performs the following operations:

In the Signal position, the Signal terminals are connected directly to the Output terminals.

In the standard voltage (STD Volt) position, the output of the precision voltage divider is connected to the Output terminals.

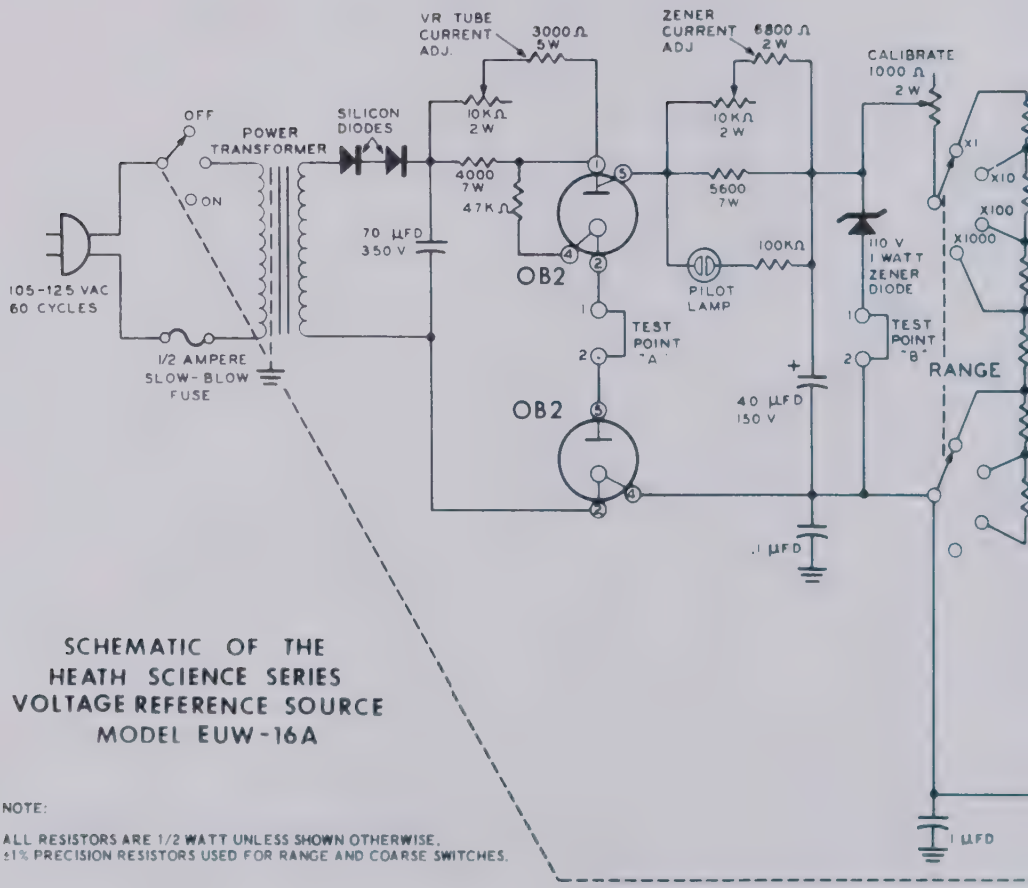
In the Sum-Difference position the output of the precision voltage divider is connected in series with the voltage at the Signal terminals. Thus, the precision voltage is either added to or subtracted from the Signal voltage, depending on the setting of the Polarity switch.

The Zero pushbutton disconnects the Output switch from the positive Output terminal, and shorts the two Output terminals together.

WARRANTY

Heath Company warrants that for a period of one year from the date of shipment, all parts in its products shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase or operation of Heath products or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or operating Heath equipment.

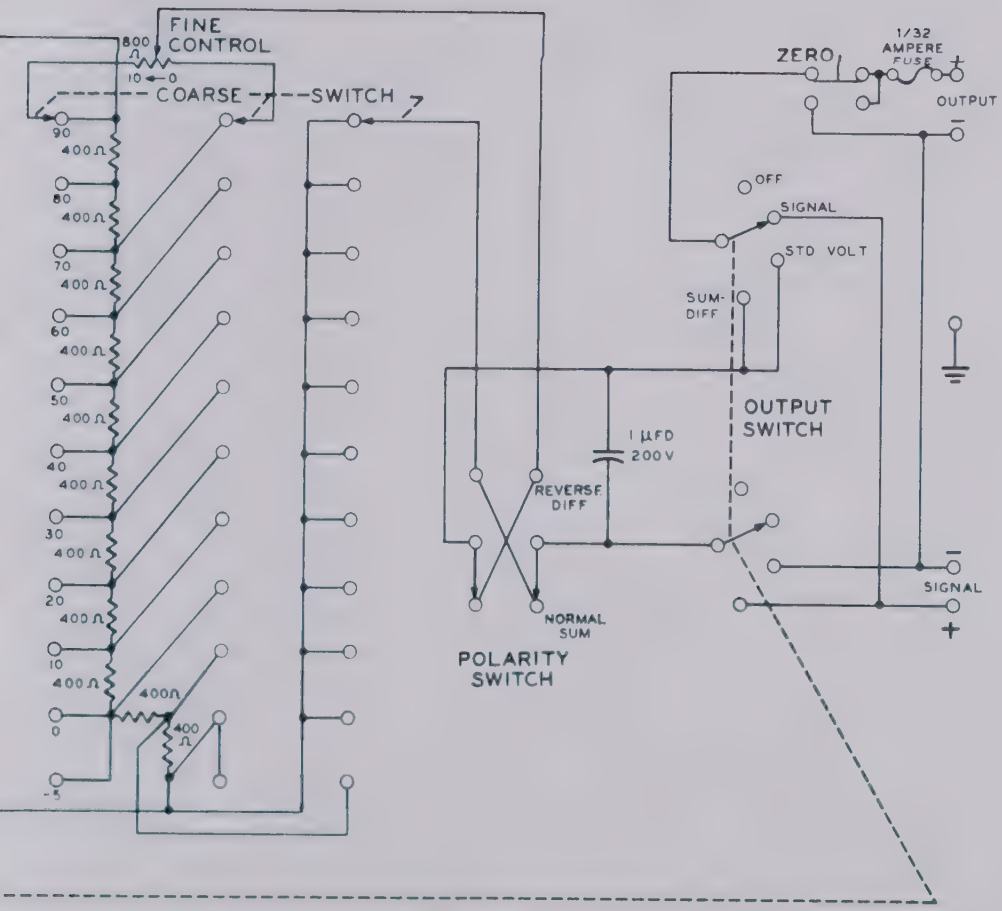
HEATH COMPANY



SCHEMATIC OF THE
HEATH SCIENCE SERIES
VOLTAGE REFERENCE SOURCE
MODEL EUW-16A

NOTE:

ALL RESISTORS ARE 1/2 WATT UNLESS SHOWN OTHERWISE.
±1% PRECISION RESISTORS USED FOR RANGE AND COARSE SWITCHES.


FINE
CONTROL
800 Ω
10 ← 0
COARSE
SWITCH
90
400Ω
80
400Ω
70
400Ω
60
400Ω
50
400Ω
40
400Ω
30
400Ω
20
400Ω
10
400Ω
0
400Ω
400 Ω
-5
ZERO
1/32
AMPERE
FUSE
+
OUTPUT
−
OFF
SIGNAL
STD VOLT
SUM-
DIFF
OUTPUT
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1 μFD
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REVERSE
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+

Heath Company warrants that for a period of one year from the date of shipment, all parts in its products shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase or operation of Heath products or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or operating Heath equipment.

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